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(54) **TIRE MOLDING APPARATUS**

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**B29C 35/00** (2006.01)  
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**B29D 30/06** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **B29D 30/0662** (2013.01); **B29D 2030/063** (2013.01); **B29D 2030/0607** (2013.01); **B29D 2030/0666** (2013.01)

(58) **Field of Classification Search**

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29/401.1

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

1,349,688	A *	8/1920	Nichols	425/50
1,917,262	A *	7/1933	Hawkinson	425/22
2,066,265	A *	12/1936	Freeman	264/501
2,729,853	A *	1/1956	Hawkinson	425/20
2,736,060	A *	2/1956	Glynn	425/25
2,932,853	A *	4/1960	Fike	425/17
3,154,814	A *	11/1964	Fike	425/25
3,170,193	A *	2/1965	Fike	425/20
3,910,735	A *	10/1975	Caretta	425/46
4,116,595	A *	9/1978	Fike et al.	425/17
4,401,156	A *	8/1983	Wojtecki et al.	165/172
4,439,876	A *	4/1984	Chalberg	4/541.6
4,446,093	A *	5/1984	Mattson	264/315

(Continued)

**FOREIGN PATENT DOCUMENTS**

JP	H09-076238	3/1997
JP	2011-126044	6/2011

**OTHER PUBLICATIONS**

Jun Eun Jae, International Search Report and Written Opinion, Jan. 23, 2013, pp. 1-9, Korean Intellectual Property Office, Daejeon Metropolitan City, ROK.

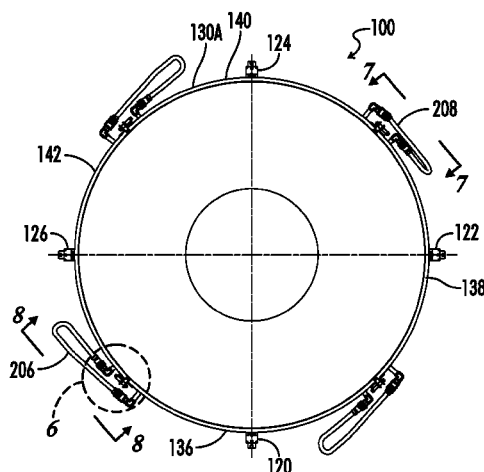
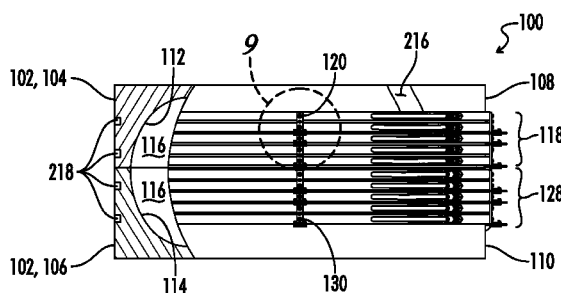
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*Primary Examiner* — Essama Omgba

(57) **ABSTRACT**

A tire mold apparatus is provided along with methods of retrofitting a tire mold, such that a tire mold of the type traditionally utilized in a dome type curing press can be modified to have external steam tracings allowing the mold to be utilized in a platen press.

**16 Claims, 10 Drawing Sheets**



(56)

**References Cited**

## U.S. PATENT DOCUMENTS

5,086,836 A \* 2/1992 Barth et al. .... 165/164  
 5,173,308 A 12/1992 Scantland et al.  
 5,186,951 A \* 2/1993 Siegenthaler ..... 425/28.1  
 5,320,510 A 6/1994 Siegenthaler  
 5,683,643 A 11/1997 Laurent  
 5,799,345 A \* 9/1998 Hansen et al. .... 4/584  
 5,803,506 A \* 9/1998 Argersinger et al. .... 285/14  
 6,131,617 A \* 10/2000 Pitzer et al. .... 138/143  
 6,402,491 B1 6/2002 Goto  
 6,410,893 B1 \* 6/2002 Yagnik et al. .... 219/540  
 6,413,068 B1 7/2002 Steidl et al.  
 6,660,122 B1 12/2003 Prakash et al.  
 6,682,687 B1 1/2004 Mitamura et al.  
 6,762,395 B2 \* 7/2004 Yagnik et al. .... 219/540  
 6,810,916 B2 \* 11/2004 Thompson ..... 138/32  
 6,841,113 B2 1/2005 Caretta  
 6,916,164 B2 7/2005 Kasper et al.  
 7,160,090 B2 1/2007 Yang et al.

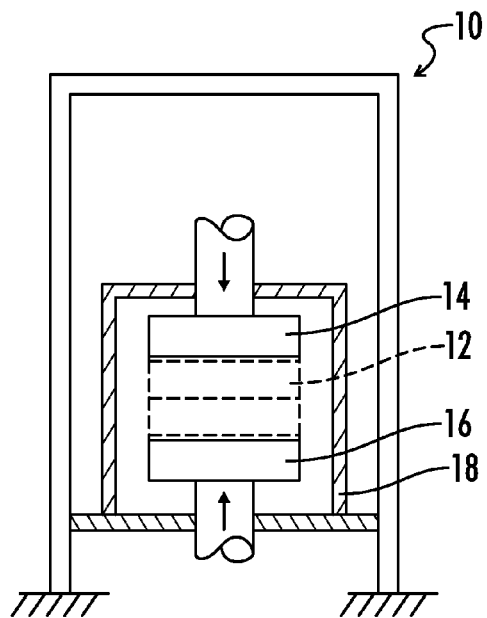
7,321,107 B2 \* 1/2008 Yagnik et al. .... 219/540  
 7,572,120 B2 \* 8/2009 Ouyahia et al. .... 425/40  
 8,469,082 B2 \* 6/2013 Perry ..... 165/185  
 8,662,156 B2 \* 3/2014 Perry ..... 165/185  
 2003/0034344 A1 \* 2/2003 Yagnik et al. .... 219/540  
 2005/0067403 A1 \* 3/2005 Yagnik et al. .... 219/540  
 2005/0095308 A1 \* 5/2005 Yang et al. .... 425/40  
 2006/0012076 A1 \* 1/2006 Caretta et al. .... 264/326  
 2006/0037132 A1 \* 2/2006 Ferguson ..... 4/541.1  
 2008/0277815 A1 11/2008 Kaneda  
 2009/0115103 A1 5/2009 Ichimaru  
 2012/0111464 A1 \* 5/2012 Kimiya ..... 152/209.1

## OTHER PUBLICATIONS

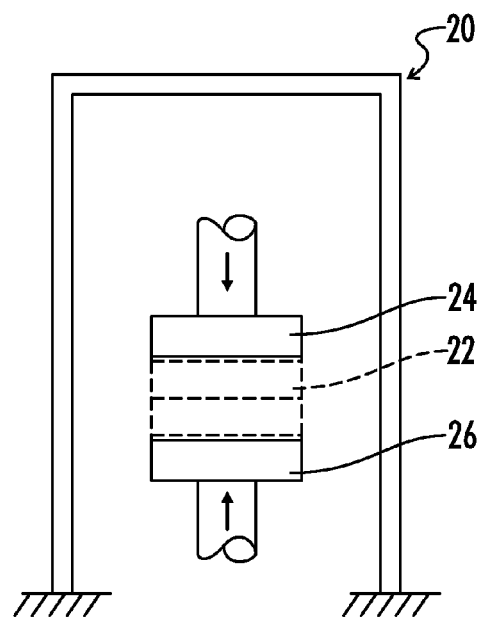
Wikipedia "Double-walled pipe" definition, printout from Wikipedia website, 2 pages (undated but admitted to be prior art).

Steam Tracing Specification Guide, Thermon, San Marcos, Texas, 18 pages (undated but admitted to be prior art).

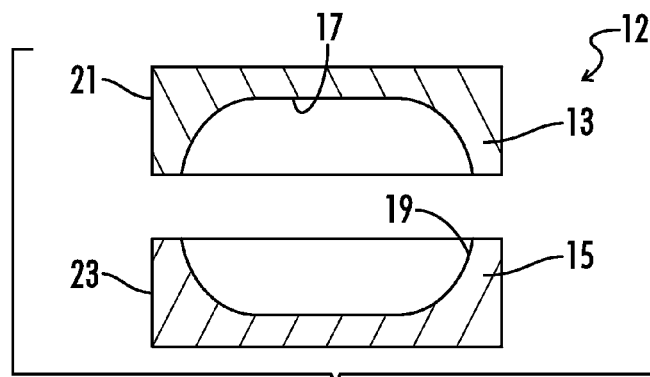
\* cited by examiner



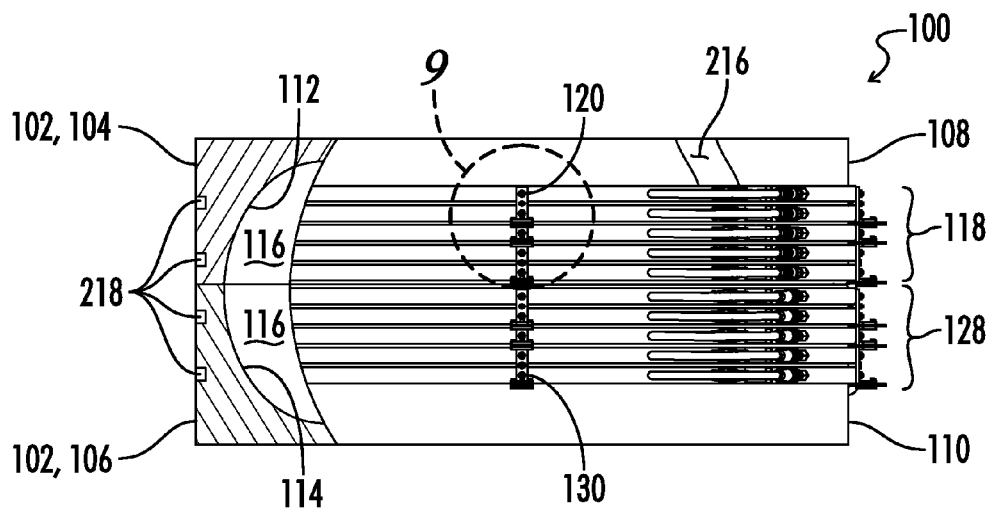
**FIG. 1**  
(PRIOR ART)



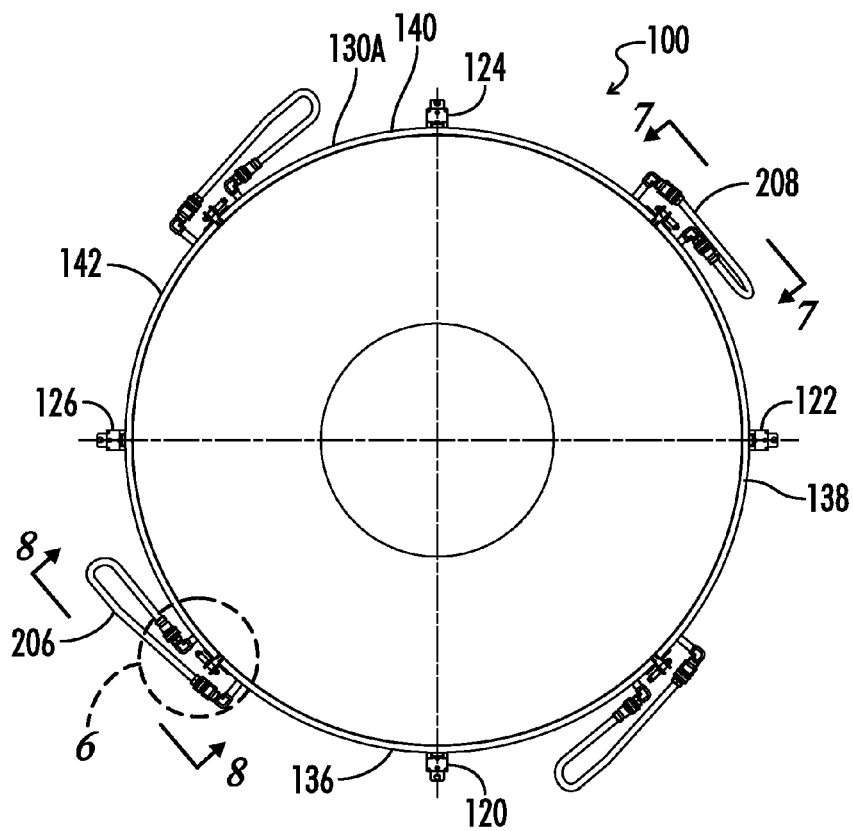
**FIG. 2**  
(PRIOR ART)



**FIG. 3**  
(PRIOR ART)



**FIG. 4**



**FIG. 5**

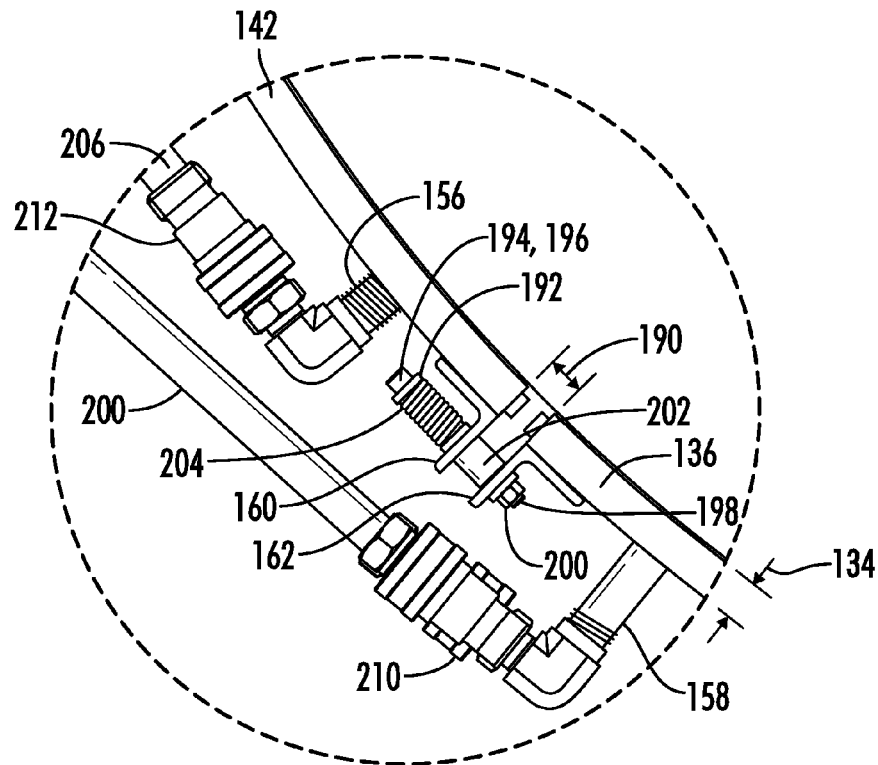


FIG. 6

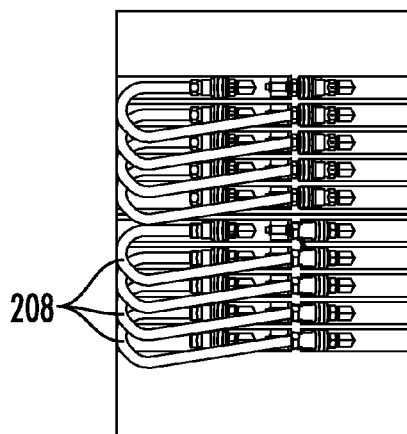


FIG. 7

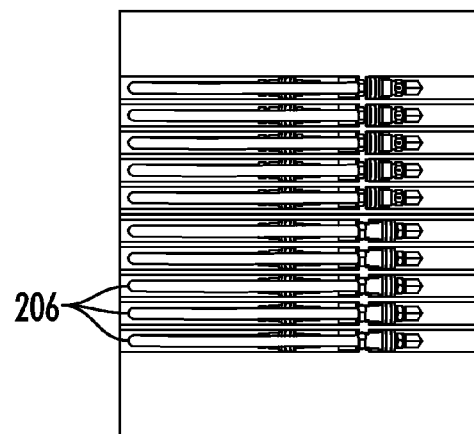
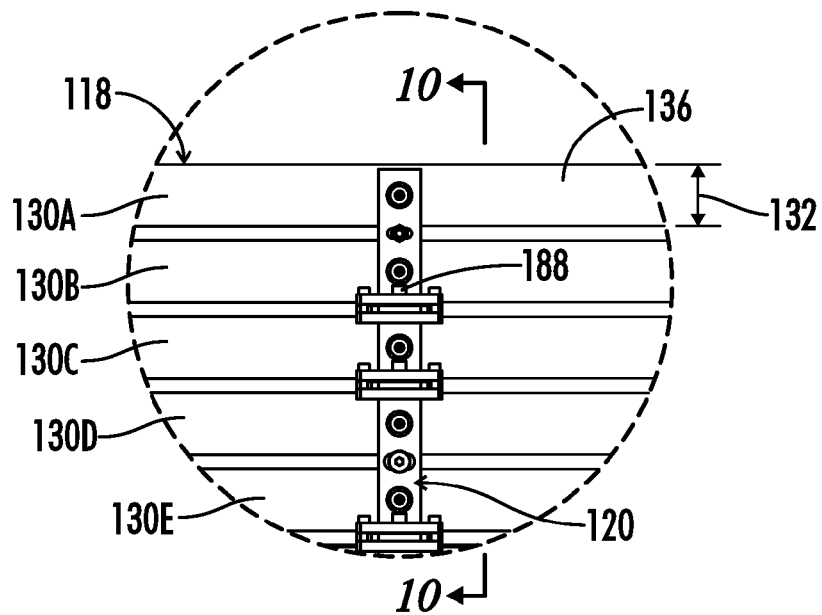
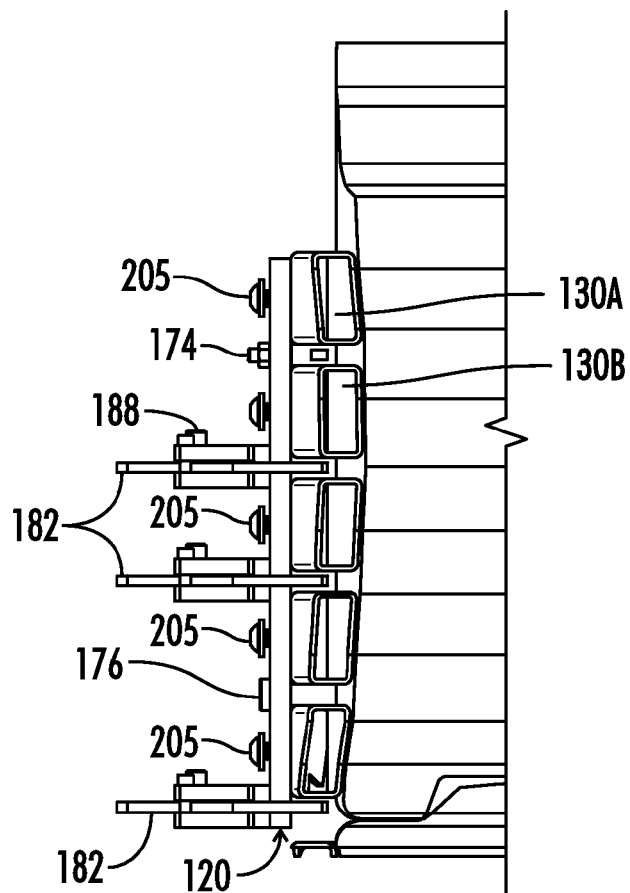


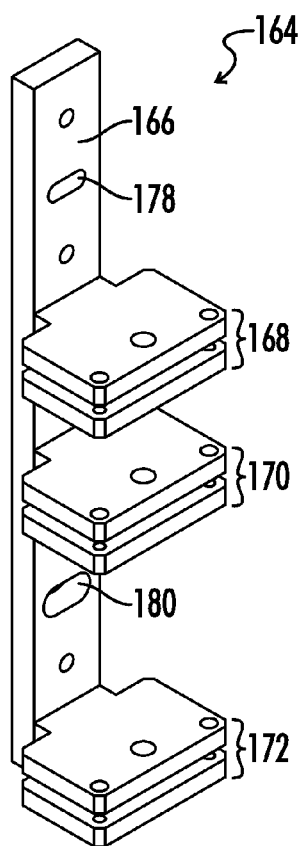
FIG. 8



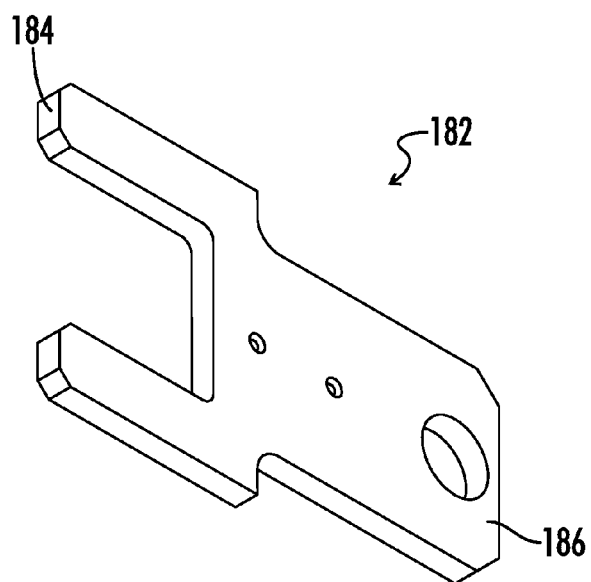
**FIG. 9**



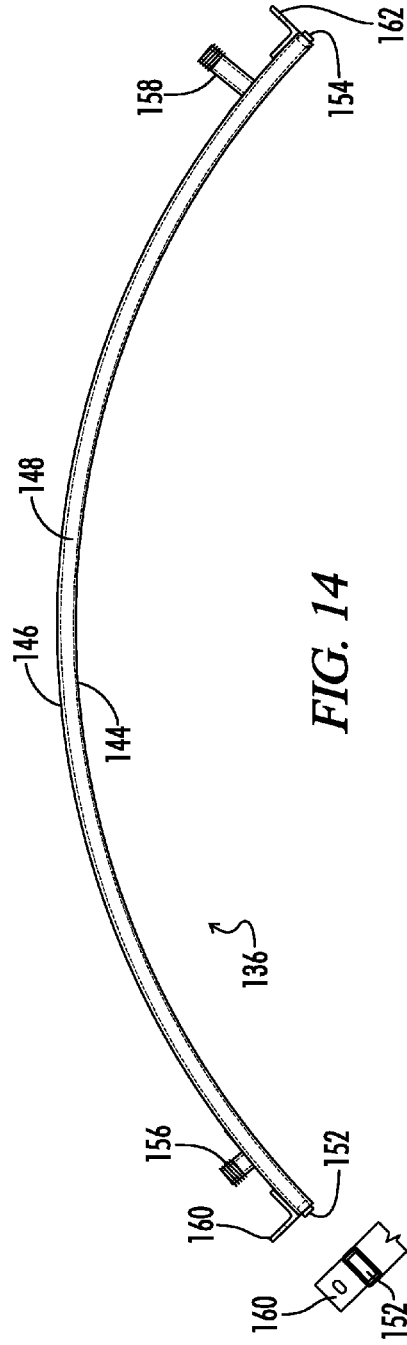
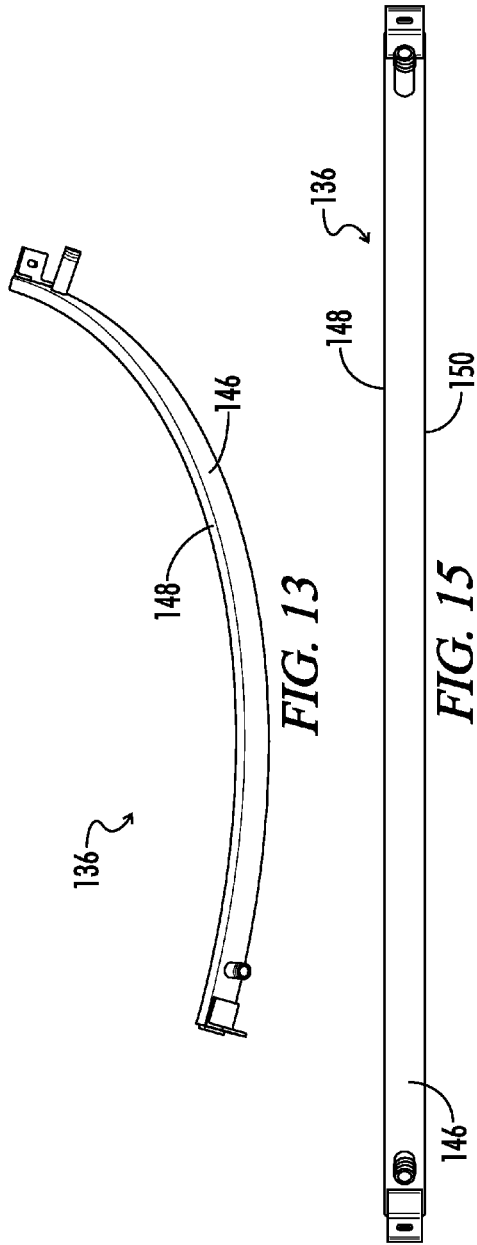
**FIG. 10**



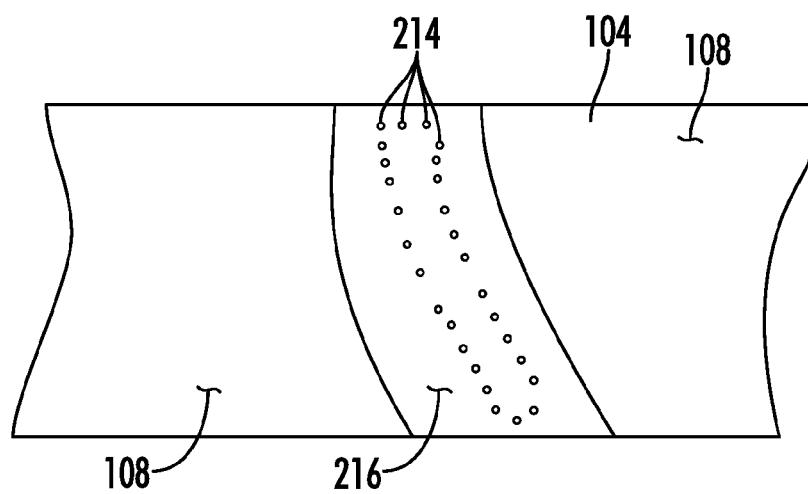
**FIG. 11**



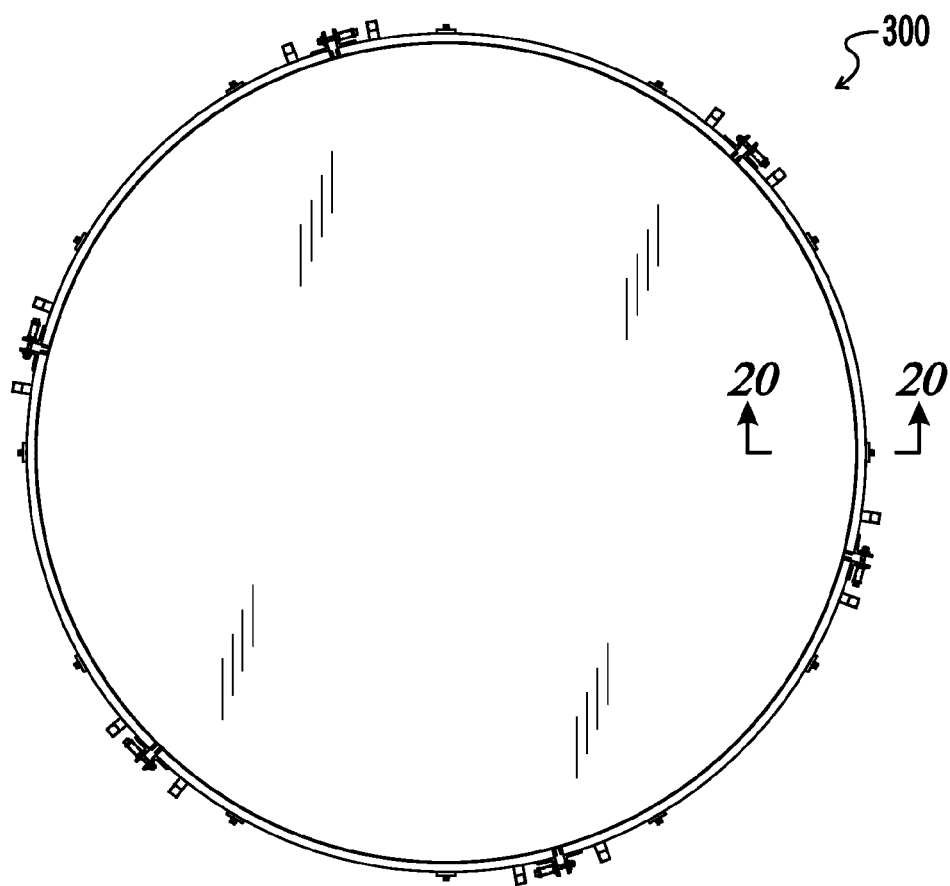
**FIG. 12**



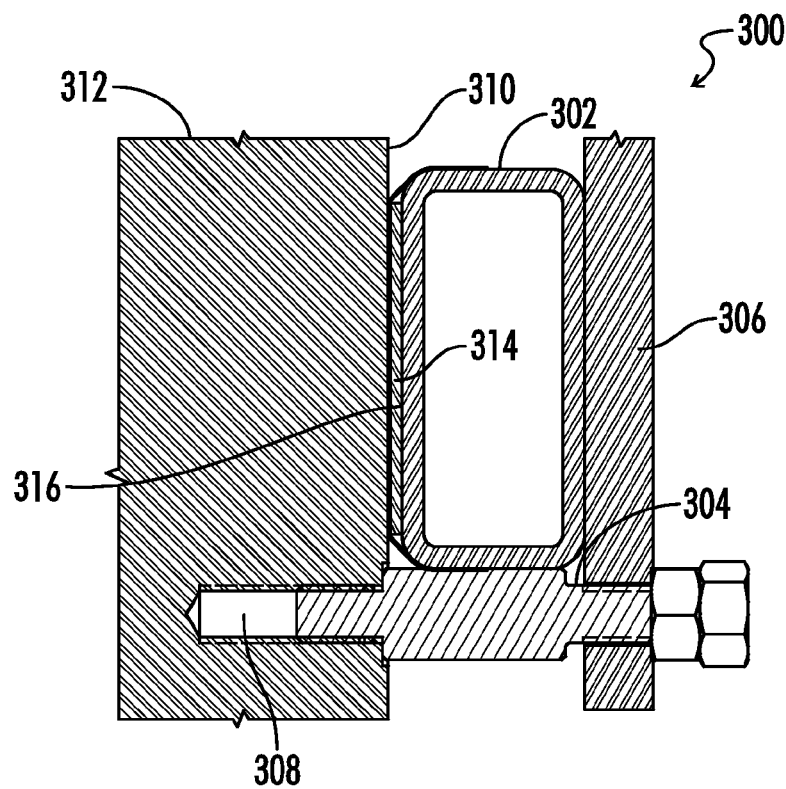
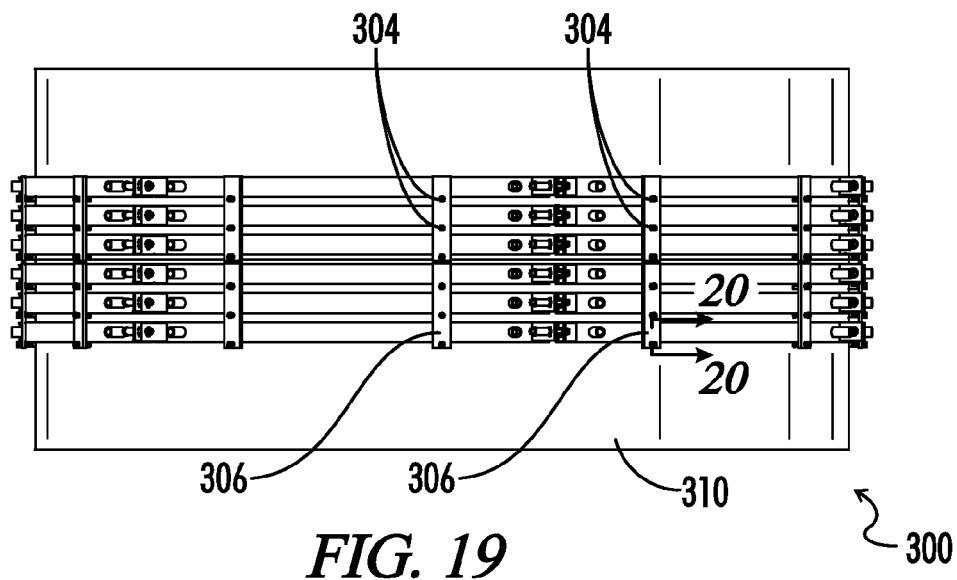


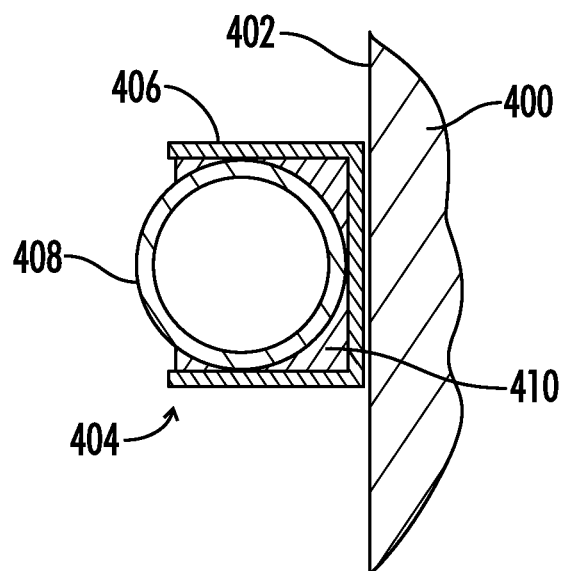


**FIG. 17**

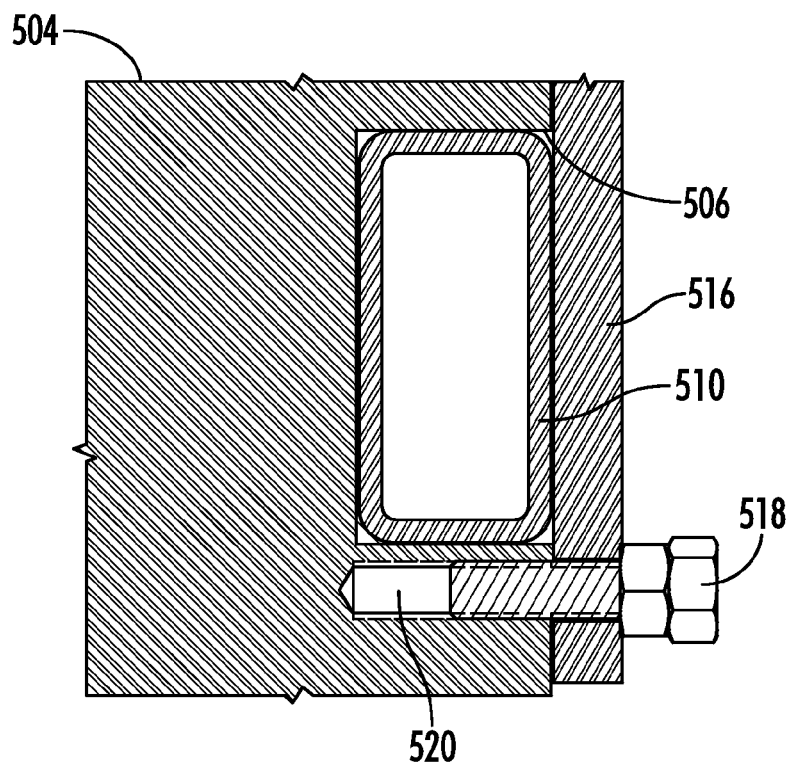
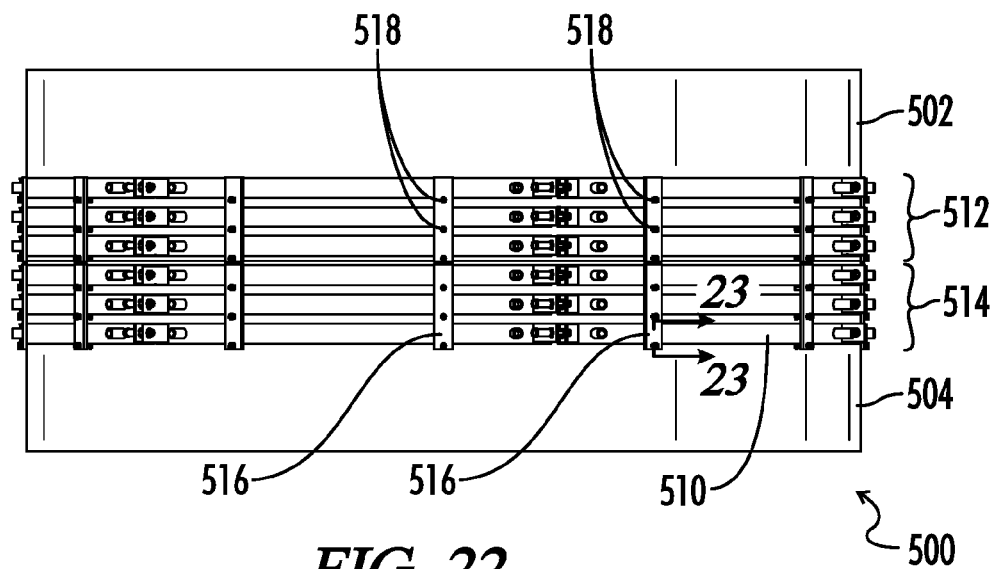


**FIG. 18**





**FIG. 21**



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## TIRE MOLDING APPARATUS

## CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/528,797 filed Aug. 30, 2011; the disclosures of which are incorporated herein by reference.

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

The present invention relates generally to apparatus for molding tires.

## 2. Description of the Prior Art

During the manufacture of a tire, a tire carcass is built up out of beads, belts and plies, and then the carcass or green tire is placed in a mold in which the rubber exterior surfaces of the tire are shaped and molded. The tire is maintained in the mold under heat and pressure for a sufficient time to cure the rubber so that the tire will maintain its shape upon removal from the mold.

The prior art includes dome type curing presses and platen type curing presses. FIG. 1 is a schematic illustration of a dome type curing press generally designated by the numeral 10. A dome type tire mold 12 indicated in dashed lines is received between upper and lower plates 14 and 16, and is surrounded by a dome 18. The dome 18 is filled with steam during the curing process and thus relatively uniformly heats the entire tire mold 12 which is contained inside the dome within the heated space. Heated water under pressure is applied internally to the green tire to conform it to the various cavities of the tire mold during the curing process.

FIG. 3 schematically illustrates a typical prior art dome type tire mold 12 which has an upper mold half 13 and a lower mold half 15. The mold halves have upper and lower cavities 17 and 19 formed therein, so that when the mold halves are brought together a cavity is defined having the exterior shape of the desired tire. The mold halves 13 and 15 typically have cylindrical outer surfaces such as 21 and 23. As noted with regard to FIG. 1, the heating of the exterior surfaces 21 and 23 of the mold 12 occurs from the steam within the steam dome 18 which surrounds the mold 12.

FIG. 2 schematically illustrates a prior art platen press type of curing press indicated by the numeral 20. In the platen press arrangement of FIG. 2 a platen press type mold 22 is received between upper and lower plates 24 and 26. The upper and lower plates 24 and 26 are heated and thus convey heat to the mold 22 held therebetween during the curing process. There is not, however, any exterior dome to contain steam, and thus there may be no heat source directed to the outer circumferential areas of the platen press type mold 22.

Depending upon the vertical thickness of the mold 22 it may or may not receive sufficient heat directly from the platens 24 and 26 to adequately cure the entire thickness of the tire. Prior art platen press molds having a sufficient vertical height to require additional heating of the central exterior portions of the mold typically are constructed with integral steam heating cavities in the mold 22.

Traditional platen press type molds are often segmented molds which open somewhat like the petals of a flower with each segment having internal heating passages formed therein.

## SUMMARY OF THE INVENTION

The present invention is directed to apparatus and methods for permitting a dome type tire mold such as the mold 12

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shown in FIGS. 1 and 3 to be used in a platen type press such as the press 20 shown in FIG. 2.

In one embodiment a tire mold apparatus includes a mold body having an upper annular mold half and a lower annular mold half. Each mold half has a cylindrical outer surface. The mold halves are constructed to fit together to define a mold cavity for molding a tire. An upper steam tracing including a plurality of upper loops surrounds the cylindrical outer surface of the upper mold half. The upper steam tracing is detachably mounted on the upper mold half. A lower steam tracing including a plurality of lower loops surrounds the cylindrical outer surface of the lower annular mold half. The lower steam tracing is detachably mounted on the lower annular mold half. This permits the upper and lower annular mold halves to be separated with the steam tracing still attached thereto.

In another embodiment a method is provided for retrofitting a tire mold originally constructed for use in a dome press so that the mold can be used in a platen press. The tire mold includes an upper mold part having an upper cylindrical outer surface and a lower mold part having a lower cylindrical outer surface. The method includes the steps of:

- (a) attaching an upper steam tracing to the upper cylindrical outer surface, the upper steam tracing including multiple upper loops extending around the upper cylindrical outer surface; and
- (b) attaching a lower steam tracing to the lower cylindrical outer surface, the lower steam tracing including multiple lower loops extending around the lower cylindrical outer surface.

Numerous objects features and advantages of the present invention will be readily apparent to those skilled in the art upon a reading of the following disclosure when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic elevation view of a prior art dome type curing press.

FIG. 2 is a schematic elevation view of a prior art platen type curing press.

FIG. 3 is a schematic elevation sectioned view of a two piece prior art tire mold for use in a dome type curing press like that of FIG. 1.

FIG. 4 is an elevation view of a tire mold apparatus of the type originally designed for use in a dome type curing press, which has been modified by the addition of external steam tracings to the upper and lower mold halves to provide external heating upon use of the tire mold in a platen type curing press.

FIG. 5 is a plan view of the tire mold apparatus of FIG. 4.

FIG. 6 is an enlarged view of the area circled and indicated as 6 in FIG. 5.

FIG. 7 is a partial elevation view of a portion of the apparatus of FIG. 5 taken along line 7-7 of FIG. 5 and showing the flexible hose connections between adjacent loops of the steam tracings.

FIG. 8 is a partial elevation view of the apparatus of FIG. 5 taken along line 8-8 of FIG. 5 and illustrating the flexible hose connections between adjacent segments of each loop of the steam tracings.

FIG. 9 is an enlarged view of the circled portion indicated by the number 9 in FIG. 4 further showing the details of a mounting bracket for attaching the steam tracings to the tire mold.

FIG. 10 is a partial elevation sectioned view taken along line 10-10 of FIG. 9 further illustrating the attachment of the steam tracings to the tire mold with the mounting bracket of FIG. 9.

FIG. 11 is a perspective view of one of the mounting brackets such as that seen in FIG. 9.

FIG. 12 is a perspective view of a supporting member utilized with the mounting bracket of FIG. 11 to support individual loops of the steam tracing as seen in FIGS. 9 and 10.

FIG. 13 is a perspective view of one arcuate segment of one of the loops of the steam tracings.

FIG. 14 is a plan view of the arcuate segment of FIG. 13.

FIG. 15 is a side elevation view of the arcuate segment of FIG. 14.

FIG. 16 is an end elevation view of the arcuate segment of FIG. 14.

FIG. 17 is a schematic elevation illustration of a portion of one of the mold halves illustrating the presence of pin vent holes in the mold and the presence of a shallow groove formed in the exterior cylindrical surface of the mold to communicate the pin vents with the atmosphere.

FIG. 18 is a plan view of an alternative embodiment for the mold tracings and their mounting on the tire mold.

FIG. 19 is an elevation view of the embodiment of FIG. 18.

FIG. 20 is an enlarged section view showing the details of the mounting of the steam tracing to the tire mold of FIGS. 18 and 19.

FIG. 21 is a schematic cross-section view of an alternative embodiment of the steam tracing.

FIG. 22 is an elevation view of another alternative embodiment for the mounting of the steam tracings.

FIG. 23 is an enlarged sectioned view along line 23-23 of FIG. 22.

#### DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 4, a tire mold apparatus is shown and generally designated by the numeral 100. The tire mold 100 includes a mold body 102 having an upper annular mold half 104 and a lower annular mold half 106. The upper mold half 104 has a cylindrical outer surface 108 and the lower mold half 106 has a cylindrical outer surface 110.

As schematically illustrated on the left hand side of FIG. 4, the upper and lower mold halves 104 and 106 include upper and lower cavities 112 and 114, respectively, which when joined together as shown in FIG. 4 define a cavity 116 having the external shape and configuration of the desired tire. Although the apparatus 100 may be used for molding any size tire, it is particularly useful on very large tires such as agricultural tires where the mold may have a height in the range of 40 to 54 inches, and the tire may have a diameter on the order of 80 inches or more.

As seen in FIG. 4, an upper steam tracing 118 including a plurality of upper loops, in this case five such loops, surrounds the cylindrical outer surface 108 of the upper mold half 104. The upper steam tracing 118 is detachably mounted on the upper mold half 104 by a plurality of bracket assemblies 120, 122, 124 and 126 the locations of which are shown in the plan view of FIG. 5. An enlarged elevation view of the bracket assembly 120 is seen in FIG. 9, and further details are shown in the sectioned view of FIG. 10.

Similarly, a lower steam tracing 128 including a plurality of lower loops surrounds the cylindrical outer surface 110 of the lower annular mold half 106. The lower steam tracing is detachably mounted on the lower annular mold half 106 by a plurality of mounting bracket assemblies such as 130 seen in

FIG. 4. The details of construction of all of the mounting bracket assemblies are similar and will be described below with regard to the enlarged views of FIGS. 9 and 10. The upper and lower steam tracings 118 and 128 are separately structurally mounted upon the upper and lower mold halves 104 and 106, respectively, so that when the mold halves 104 and 106 are separated to allow a tire to be placed in the mold or removed from the mold, the mold halves can be moved with their respective steam tracings still attached thereto.

The steam tracings 118 and 128 are each of a modular construction. As noted each steam tracing includes a plurality of loops. For example, the upper steam tracing 118 which is seen in the enlarged views of FIGS. 9 and 10 includes five upper loops 130A, 130B, 130C, 130D and 130E.

In the embodiment illustrated each loop is formed from tubing having a rectangular cross-section, with the rectangular cross-section being defined by a height 132 seen in FIG. 9 and a width 134 seen in FIG. 6.

As best seen in FIG. 5, the first upper loop 130A is made up of a plurality of arcuate segments joined together to form a 360° loop. In the embodiment of FIG. 5, the upper loop 130A includes four substantially 90° arcuate segments 136, 138, 140 and 142. Although the embodiment illustrated includes four substantially equal length arcuate segments each subtending approximately 90° of the loop, other arrangements are possible. For example in the embodiment illustrated in FIGS. 18-19 there are six arcuate segments each subtending approximately 60° of the tracing loop.

The details of construction of one of the arcuate segments such as 136 are shown in FIGS. 13-16. There it is seen that the arcuate segment 136 has been formed into an arc defining a portion of a circle and has been bent along its thickness 134. The arcuate segment 136 can be described as having a radially inner planar surface 144, a radially outer planar surface 146, an upper surface 148, and a lower surface 150. The radially inner planar surface 144 is designed to closely conform to and engage the cylindrical outer surface 108 of upper mold half 104. In the embodiment illustrated the radially inner planar surface 144 directly engages the cylindrical outer surface 108 of the upper annular mold half 104 with no heat transfer media between the tubing and the cylindrical outer surface of the mold. It will be appreciated, however, that in other embodiments a heat transfer media can be placed between the tubing and the outer surface of the mold. For example, in the embodiment shown in FIG. 20 a layer of heat transfer media is placed between the tubing of the steam tracing and the outer surface of the mold.

As seen in FIG. 14, the peripheral ends of the tubing forming the arcuate segment 136 are plugged. Cylindrical nipples 156 and 158 extend radially outward from the tubing near its peripheral ends and are communicated with the interior of the tubing to allow a means of fluidly connecting adjacent segments of tubing as further described below.

Also, adjacent each of the peripheral ends 152 and 154 L-shaped angles are welded to the tubing and include outward radially outwardly extending mounting flanges 160 and 162.

In the embodiment illustrated, the arcuate segment 136 of upper loop 130A is structurally supported from the upper annular mold half 104 by the bracket assembly 120. The bracket assembly 120 also supports an arcuate segment of each of the other upper loops 130B, 130C, 130D and 130E as is best illustrated in the enlarged views of FIGS. 9 and 10. For each upper loop, however, each arcuate segment of that loop is separately structurally supported from the upper annular mold half 104. Thus, each of the arcuate segments 136, 138, 140 and 142 of upper loop 130A are separately structurally

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supported from the upper annular mold half **104** by bracket assemblies **120**, **122**, **124** and **126**, respectively.

The primary component of the bracket assembly **120** is a mounting bracket **164** best seen in FIG. **11**, which includes a vertical spine **166** and three pairs of mounting plates **168**, **170** and **172**.

The mounting assembly **120** is designed to be structurally connected to the upper mold half **104** in a manner which requires a minimal amount of modification of the upper annular mold half. In this case, the mounting bracket **164** is designed to be attached to the upper annular mold half **104** with two mounting studs **174** and **176** received through two mounting slots **178** and **180**, respectively, defined in the spine **166** of mounting bracket **164**.

The manner of assembly of the arcuate segment **136** and the four arcuate segments therebelow with the mounting bracket **120** as seen in FIGS. **9** and **10** will now be described.

First, the mounting bracket **164** is partially attached to the upper mold half **104** by placing the upper mounting stud **174** through slot **178** and engaging a threaded hole **218** (see FIG. **4**) formed in the outer surface **108** of mold **104**.

Then, the arcuate segment **136** of upper loop **130A** is placed between the spine **166** of bracket **164** and the exterior surface **108** of upper mold half **104** and is rested on top of the mounting stud **174**.

Then an arcuate segment of the upper loop **130B** is inserted from below between the spine **166** of bracket **164** and the outer surface **108** of upper mold half **104** and is raised to substantially the position shown in FIGS. **9** and **10**. Then a retaining tab **182** such as seen in FIG. **12** is inserted between the upper pair of mounting plates **168** so that it extends radially inward below the lower surface of the upper loop **130B** as seen in FIG. **10**.

The retainer tab **182** has a forked radially inner end **184** and a radially outer end **186**. The forked inner end **184** is bifurcated and extends on either side of the spine **166** of mounting bracket **164** radially inward past the spine **166** so as to fit under the upper loop **130B** on either side of spine **166** as best seen in FIG. **10**. The retainer tab **182** may be held in place between the plates **168** by a spring loaded ball detent member **188**.

Then in a similar fashion an arcuate segment of the third upper loop **130C** is raised into place below the tab **182** and then a second one of the tabs **182** is placed in the pair of flanges **170** and extended under the third loop **130C**. Then, an arcuate segment of the fourth loop **130D** is raised up into place and the second mounting stud **176** is inserted through slot **180** and under the loop **130D** and threaded into place into a threaded mounting hole **218** in the outer surface of the upper mold half **104**. Then the final loop **130E** is raised into place and a third mounting tab **182** is placed between the pair of mounting plates **172** and extended under the upper loop **130E**.

All of the mounting tabs may utilize spring loaded ball detents **188** to hold them in place relative to their respective mounting plates.

In a similar fashion the other arcuate segments of each upper loop **130A-130E** are structurally supported from the upper mold half **104** by the other mounting bracket assemblies **122**, **124** and **126**.

Adjacent peripheral ends of adjacent arcuate segments of each of the loops are structurally connected together as shown in FIG. **6**. The circumferential lengths of the arcuate segments are selected so that when the four arcuate segments of a loop are mounted equally spaced around the circumference of the mold, there is a gap such as **190** between the peripheral ends of adjacent arcuate segments. A resilient structural connector **192** extends across the gap **190** and biases the arcuate seg-

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ments circumferentially toward each other so that each upper loop is held in tension about the upper cylindrical outer surface **108** of upper mold half **104**. The resilient structural connector **192** includes a bolt **194** extending from a bolt head **196** to a threaded end **198** with a nut **200** received on the threaded end **198**.

A spacer **202** is received about the bolt **194** and is placed between the mounting flanges **160** and **162** to define the minimum dimension of the gap **190**. A coiled spring **204** is received about the bolt **194** and located between the bolt head **196** and the mounting flange **160** so as to resiliently bias the flanges **160** and **162** circumferentially toward each other, while allowing the flanges to move some distance apart so that the gap **190** widens to accommodate thermal expansion of the mold **104**. It is the springs **204** which provide the circumferential tension within the loop **130A**.

After each of the arcuate segments has been properly placed in association with its respective mounting bracket assembly such as **120**, the arcuate segments can be pushed firmly against the outer surface **108** of upper mold half **104** by set screws **205**.

As is best seen in FIGS. **5** and **8**, adjacent arcuate segments of each loop are fluidly connected together by a flexible hose such as **206**. For example in FIG. **6** and FIG. **5**, the flexible hose **206** is shown connecting the arcuate segments **136** and **142** of upper loop **130A**. A similar flexible hose connection is shown in FIG. **5** between arcuate segment **136** and arcuate segment **138**, and another is shown between arcuate segment **140** and arcuate segment **142**. In FIG. **5**, however, the arcuate segments **138** and **140** are not directly fluidly connected together, but instead the arcuate segment **138** is fluidly connected by a flexible hose **208** to an arcuate segment of the next lower loop **130B** lying immediately below the arcuate segment **140** of FIG. **5**.

In this manner the multiple upper loops of upper steam tracing **118** are fluidly connected together in series such that steam entering for example the upper loop **130A** will flow around the loop **130A** then through hose **208** into the loop **130B**, and then in a similar fashion around loop **130B** and then into loop **130C**, etc. The fluid connections between the loops can of course be made in any desired manner to provide any desired flow pattern of the steam through the steam tracing **118**.

Similarly, the loops of lower steam tracing **128** are connected together. The lower steam tracing **128** can also be fluidly connected in series with the upper steam tracing **118**, or they may be completely separately fluidly connected to a suitable steam source. If there are fluid connections between the upper steam tracing **118** and the lower steam tracing **128** they should be provided with a sufficient flexibility so as to allow the necessary separation of the upper and lower mold halves during operation of the mold.

As seen in FIG. **6**, each of the flexible hoses is preferably connected to the fluid nipples **156** and **158** of the tubing via fluid quick connect couplings such as **210** and **212**.

As schematically illustrated in FIG. **17**, each of the mold halves such as upper mold half **104** will have a large number of relatively small pin vent holes such as **214** extending from the inner cavity **112** to the outer cylindrical surface **108** to allow venting of the mold as the rubber portions of the tire are molded into the cavity. It is important that the upper steam tracing **118** not block these pin vent holes **214**. To that end, the cylindrical outer surface **108** of upper mold half **104** should have a shallow recess such as **216** formed therein so as to join a plurality of the pin vent holes **214** together within a single recess **216** and to provide communication of those pin vent

holes with some portion of the upper cylindrical outer surface **108** which is not covered by the upper steam tracing **118**.

The tire molding apparatus **100** provides a number of advantages. Due to the relative small volume of the tracings there is no requirement for ASME certification as a pressure vessel. The steam tracings are of relatively low cost construction as compared to molds having integral steam chambers. The steam tracings may be removed for mold cleaning. Due to the modular construction, if one portion of the steam tracing is damaged, it can be repaired just by replacing the damages segment. The steam tracing is light weight and easy to handle. Methods of Retrofitting

Although it is possible to manufacture the tire mold apparatus **100** as a complete new assembly at manufacture, the construction of apparatus **100** is particularly designed for the purpose of modifying a tire mold such as the mold **12** of FIGS. **1** and **3** originally constructed for use in a dome press to allow the modified mold in a platen press such as illustrated in FIG. **2**.

Such a method of retrofitting can generally be described as attaching the upper steam tracing **118** to the upper cylindrical outer surface **108** of upper mold half **104**, and attaching the lower steam tracing **128** to the lower cylindrical outer surface **110** of lower mold half **106**. Each of the steam tracings includes multiple loops as described above.

Prior to attaching the steam tracings to their respective mold halves, any necessary recesses such as recess **216** illustrated in FIG. **17** should be formed in the cylindrical outer surfaces of the mold halves to ensure that any pin vent holes which would otherwise be covered by the steam tracings, are provided with a clear communication path after the attachment of the steam tracings.

Furthermore, prior to attaching the steam tracings to the mold halves, each mold half is preferably modified by drilling and threading a plurality of mounting holes **218** into its cylindrical surface, with the mounting holes being properly located to receive the mounting studs such as **174** and **176** shown in FIG. **10**.

As previously described each loop of each steam tracing is assembled from a plurality of arcuate loop segments. Those segments can be first attached to the mold and then the arcuate segments of each loop structurally and fluidly connected together as described above. It is also possible to structurally connect the arcuate segments of each loop to form a complete loop and to then assemble the complete loop with four associated mounting bracket assemblies in generally the same manner as described above. The structural connection of adjacent loop segments includes structurally and resiliently connecting adjacent ends of adjacent loop segments of each loop together so that each loop is held in loop tension about the cylindrical outer surface of its associated mold half.

In the embodiment illustrated each arcuate loop segment of a given loop is separately structurally supported from the upper mold part by one of the mounting bracket assemblies.

After the loops of a steam tracing are structurally connected to the respective mold path, the adjacent segments of the loops are fluidly connected together, and adjacent loops are fluidly connected together as previously described. Also an insulation blanket (not shown) may be wrapped about the assembled steam tracing and mold half assemblies.

In the disclosed embodiment the steam tracings are formed from rectangular cross-section tubing arranged such that a radially innermost planar exterior tubing surface of each loop is placed in heat conducting contact with the cylindrical outer surface of its associated mold half. In the embodiment illustrated that radially innermost planar exterior tubing surface is

directly engaged with the outer cylindrical surface without any heat conducting media therebetween.

Alternative Embodiment of FIGS. **18-20**

FIG. **19** is an elevation view of an alternative tire mold apparatus generally designated by the numeral **300**. The tire mold **300** of FIGS. **18-20** illustrates several possible modifications as compared to the tire mold apparatus **100** described above. A first modification is that each loop of each steam tracing is divided into six segments rather than four. A second modification is that each steam tracing in this case includes only three loops rather than the five loops of the apparatus **100**. A third modification as best seen in the enlarged view of FIG. **20** is a different arrangement for mounting the steam tracings on the tire mold. A fourth modification is the use of heat transfer media between the tubing of the steam tracing and the outer surface of the tire mold.

Turning to the enlarged view of FIG. **20**, each of the arcuate tubing segments such as **302** is supported at one or more circumferential positions on a mounting bolt **304** which extends through a vertical mounting strap **306** and into a threaded bore **308** formed in the cylindrical outer surface **310** of the mold half **312**. A layer **314** of heat transfer media is placed on a radially innermost outer surface **316** of the arcuate tubing segment **302**, and the mounting bolt **304** is used to pull the mounting strap **306** radially inward so as to tightly hold the arcuate segment **302** in heat conducting engagement with the outer surface **310** of mold half **312**.

In a similar fashion, as best seen in FIG. **19**, mounting bolts **304** extend through the mounting straps **306** adjacent and just below each of the loops of each steam tracing.

Structural and fluid connection of adjacent arcuate segments and of adjacent loops for the tire mold apparatus **300** are made in a similar fashion to that described above for the tire mold apparatus **100**.

Alternative Embodiment of FIG. **21**

Turning now to FIG. **21**, a schematic cross-sectioned view is shown of an alternative design for a steam tracing which instead of using the rectangular tubing of the apparatus **100** or apparatus **300**, uses a circular cross-section tubing **408** held in place within a channel shaped support **406**.

Thus, in FIG. **21** a mold half **400** has an exterior outer surface **402**. An arcuate segment of a steam tracing loop is generally designed by the numeral **404** and is shown in cross-section. The arcuate segment **404** is made up of a channel shaped member **406** having a circular cross-section steam conducting tubing **408** received therein. Preferably a heat transfer media **410** fills in any gaps between the circular cross-section tubing **408** and the channel shaped carrier **406**. The arcuate segments of the channel shaped carrier **406** may be structurally connected together in a manner generally like that shown in FIG. **6** using resilient structural connectors such as **192**. The arcuate segments of circular cross-section tubing such as **408** may be fluidly connected together in a manner similar to the fluid connections described above for the rectangular cross-section tubing.

Alternative Embodiment of FIGS. **22-23**

FIGS. **22-23** show an alternative embodiment in which the steam tracings are carried in grooves machined into the outer surface of the mold. In FIG. **22** an alternative tire molding apparatus **500** includes upper and lower mold halves **502** and **504**. As best seen in FIG. **23**, the cylindrical outer surfaces of each of the mold halves have a plurality of annular grooves such as **506** formed therein. The grooves may be formed by machining of the mold halves. The loops such as **510** of upper and lower steam tracings **512** and **514** are received in and supported by the grooves **506**.



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The loops may be held in place within their respective grooves by mounting straps such as **516** attached with bolts **518** received in threaded bores **520** formed in the cylindrical outer surfaces of the mold halves. If desired, heat transfer media may be placed between the loops and the grooves in which they are received.

Thus it is seen that the apparatus and methods of the present invention readily achieve the ends and advantages mentioned as well as those inherent therein. While certain preferred embodiments of the invention have been illustrated and described for purposes of the present disclosure, numerous changes in the arrangement and construction of parts and steps may be made by those skilled in the art which changes are encompassed within the scope and spirit of the present invention as defined by the appended claims.

What is claimed is:

1. A tire mold apparatus, comprising:

a mold body including an upper annular mold half and a lower annular mold half, each mold half having a cylindrical outer surface, the mold halves constructed to fit together to define a mold cavity for molding a tire;

an upper steam tracing including a plurality of upper loops surrounding the cylindrical outer surface of the upper annular mold half, the upper steam tracing being detachably mounted on the upper annular mold half;

a lower steam tracing including a plurality of lower loops surrounding the cylindrical outer surface of the lower annular mold half, the lower steam tracing being detachably mounted on the lower annular mold half, so that the upper and lower annular mold halves can be separated with the steam tracings attached to the mold halves;

wherein each upper loop of the upper steam tracing includes a plurality of arcuate segments of less than 360° joined together to form a 360° loop;

wherein adjacent arcuate segments of each upper loop have a gap therebetween; and

a resilient structural connector extending across the a and biasing the adjacent arcuate segments toward each other so that each upper loop is held in tension about the upper cylinder outer surface.

2. The apparatus of claim 1, wherein:

each upper loop of the upper steam tracing includes a radially inner planar surface engaging the cylindrical outer surface of the upper annular mold half.

3. The apparatus of claim 2, wherein:

each upper loop is formed from tubing having a rectangular cross-section.

4. The apparatus of claim 3, wherein:

the rectangular cross-section tubing of each upper loop directly engages the cylindrical outer surface of the upper annular mold half with no heat transfer media between the tubing and the cylindrical outer surface.

5. The apparatus of claim 1, wherein:

each arcuate segment is separately structurally supported from the upper annular mold half.

6. The apparatus of claim 1, further comprising:

a plurality of flexible hoses, each hose fluidly connecting two adjacent segments of each upper loop.

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7. The apparatus of claim 6, wherein:

adjacent upper loops are fluidly connected together by a flexible hose.

8. The apparatus of claim 1, wherein the arcuate segments are of substantially equal length.

9. The apparatus of claim 1, wherein the upper loops are fluidly connected together in series.

10. A method of retrofitting a tire mold originally constructed for use in a dome press for use in a platen press, the tire mold including an upper mold part having an upper cylindrical outer surface and a lower mold part having a lower cylindrical outer surface, the method comprising:

(a) attaching an upper steam tracing to the upper cylindrical outer surface, the upper steam tracing including multiple upper loops extending around the upper cylindrical outer surface, the attaching including; assembling each upper loop from a plurality of arcuate loop segments, wherein each loop segment has two ends; and

structurally and resiliently connecting adjacent ends of adjacent loop segments of each upper loop together so that each upper loop is held in loop tension about the upper cylindrical outer surface; and

(b) attaching a lower steam tracing to the lower cylindrical outer surface, the lower steam tracing including multiple lower loops extending around the lower cylindrical outer surface.

11. The method of claim 10, wherein the upper mold part includes a plurality of pin vent holes, the method further comprising:

prior to step (a), forming a recess in the upper cylindrical outer surface joining a plurality of the pin vent holes and providing communication of the pin vent holes with a portion of the upper cylindrical outer surface not covered by the upper steam tracing in step (a).

12. The method of claim 10, further comprising:

prior to step (a), drilling and threading a plurality of mounting holes in the upper cylindrical surface; and wherein step (a) further comprises attaching a plurality of mounting brackets to the mounting holes, and supporting the upper steam tracing from the mounting brackets.

13. The method of claim 10, wherein:

step (a) further comprises supporting each loop segment of each upper loop separately from the upper mold part.

14. The method of claim 10, wherein:

step (a) further comprises fluidly connecting adjacent segments of an upper loop with a flexible connecting conduit, and fluidly connecting adjacent upper loops with another flexible connecting conduit.

15. The method of claim 10, wherein:

in step (a), the upper steam tracing is formed from rectangular cross-section tubing, and in step (a) a radially innermost planar exterior tubing surface of each upper loop is placed in heat conducting contact with the upper cylindrical outer surface.

16. The method of claim 15, wherein:

in step (a), the radially innermost planar exterior tubing surface is directly engaged with the upper cylindrical outer surface without any heat conducting media therebetween.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 9,138,950 B2  
APPLICATION NO. : 13/251319  
DATED : September 22, 2015  
INVENTOR(S) : Byers et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the claims,

Column 9, line 39, second instance of “a” should be “gap”

Signed and Sealed this  
Twenty-ninth Day of March, 2016

A handwritten signature in black ink, reading "Michelle K. Lee". The signature is fluid and cursive, with the first letters of each name being capitalized and prominent.

Michelle K. Lee  
*Director of the United States Patent and Trademark Office*